Improved Bezel Design for Surface Mount Display Modules

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention pertains to the art of electronic display modules, and more particularly, to the attachment of components such as bezels and reflectors relying upon heat staking to surface mount display modules.

Art Background

Electronic displays are used in a variety of devices to display information to the user. A variety of technologies are used, including Liquid Crystal Displays (LCD), Vacuum Fluorescent Displays (VFD), and Light Emitting Diode displays (LED).

With the development of brighter and more colorful LED materials, LED displays are becoming more popular.

These displays are typically produced as subassemblies or components for inclusion in more complex devices. A display is typically manufactured on a small printed circuit board which contains the display material, LED, LCD, or VFD. It is often desirable to mount a plastic component such as a bezel or reflector to the display circuit board to shape or improve the display. A bezel serves a number of purposes, from protecting the display elements to directing and diffusing light from elements such as LEDs, adding legends or descriptive information, and the like. The bezel is typically made from a plastic or thermoplastic material, and is attached to the display circuit board by heat staking a plurality of mounting stakes from the bezel through mounting holes on the display circuit board. Similarly, and particularly for LED displays, a reflector may also be used to diffuse and couple light from LED chips mounted to the display circuit board. This reflector is typically mounted to the display circuit board by heat staking.

The process of heat staking involves passing a plastic member called a stake through a mounting hole in the display circuit board. The stake is heated, deforming the plastic material to cover part of the surrounding display circuit board, securing the stake in place.

The completed display circuit board must be connected to the larger electronic assembly. One approach is to provide a connector on the display circuit board, allowing connections to be made to the larger assembly. Another approach is to provide connecting pins or a leadframe base on the display circuit board, providing it with leads similar to those used in integrated circuit packages. Neither of these approaches is desirable, as they add cost and complexity to not only the display module, but also to the overall device.

Many electronic devices manufactured today use surface-mount techniques, where components are mounted and soldered in place on the surface of a circuit board.

It is desirable to treat display modules as surface-mountable components. Doing so allows the use of automated assembly equipment, reducing manufacturing time and cost. To be suitable for surface mount, the bottom surface of the display module must be precisely planar. Irregularities in the bottom surface of the display module introduce soldering problems when mounting the display module to the larger device, such as poor wetting, open connections, solder bridging, and solder joint deformation.

Unfortunately, heat staking produces irregularities in the lumps of thermoplastic formed during the heat staking process. These irregularities must be reworked to make the display circuit board suitable for use in a surface-mount environment. This rework is not only time consuming and therefore costly, but if significant material is removed, the holding strength provided by the stake is weakened considerably.

SUMMARY OF THE INVENTION

An improved electronic display module suitable for surface mounting features recesses in the display circuit board for containing reflowed plastic material resulting from heat staking the mounting stakes from a plastic component such as a bezel or reflector.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is described with respect to particular exemplary embodiments thereof and reference is made to the drawings in which:

Fig. **1** shows a side view of a printed circuit board with stakes,

Fig. **2** shows a side view of a printed circuit board with reformed stakes,

Fig. **3** shows a side view of a printed wiring board according to the present invention,

Fig. **4** shows a side view of a printed wiring board with reformed stakes, and

Figs. **5, 6,** and **7** show additional embodiments of the invention.

DETAILED DESCRIPTION

Fig. **1** shows a side view of a printed circuit board **100**. For clarity, conductive traces on the top and bottom of the board are not shown. Plastic element **120**, such as a reflector or bezel, mounts to circuit board **100** by means of stake **130** through hole **140** in circuit board **100**. As shown in Fig. **1**, stake **130** is barbed as an aid to assembly; they may also be straight, or have tapered tips to facilitate assembly.

As shown in Fig. **2**, the end of stake **130** is heated and reformed, leaving lump **150** securing component **120** in place. The height and nonuniformity of these lumps precludes the use of printed circuit board **100** in a surface mount environment without rework to remove lump **150**.

Fig. **3** shows a printed circuit board according to the present invention. In one embodiment of the invention, printed circuit board **100** has recess **110** for stake **130**. As shown in Fig. **4**, when stake **130** is reformed, lump **150** is contained within recess **110**, leaving the bottom surface of printed circuit board **100** flat, reducing or eliminating the need for rework.

It is important that recess **110** be able to contain heat stake lump **150**. For this reason, a thicker printed circuit board substrate material must be used, on the order of 1.6mm, or thick enough so that recess **110** is able to contain the volume of heat stake lump **150**.

Where Fig. **4** shows recess **110** as having a stepped cross section, Fig. **5** shows an additional embodiment in which recess **110** is V-shaped. Fig. **6** shows an additional embodiment with straight sides and a V-shaped bottom. Fig. **7** shows an additional embodiment which is U-shaped.

The foregoing detailed description of the present invention is provided for the purpose of illustration and is not intended to be exhaustive or to limit the invention to the precise embodiments disclosed. Accordingly the scope of the present invention is defined by the appended claims.